In the Claims:

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1. (Currently Amended) A method for shifting the bandgap energy of a quantum well layer comprising:

introducing ions into a quantum well structure at an elevated temperature that is in the range of from about 200 °C to near the crystal damage temperature, wherein the introduced ions are selected from a group consisting of oxygen, gallium, fluorine, nitrogen, boron, argon, arsenic, xenon and phosphorus; and wherein the quantum well structure is formed over a substrate and includes at least:

an upper barrier layer;

a lower barrier layer; and

a quantum well layer disposed between the upper barrier layer and the lower barrier layer; and wherein the ions are introduced no closer than 0.5 microns from the upper and lower barrier layers; and

thermally annealing the quantum well structure;

wherein quantum well interdiffusion is induced and the bandgap energy of the quantum well layer is shifted.

2. (Cancelled)

3. (Previously Cancelled)

4. (Previously Amended) The method of claim 1, wherein the introducing step creates crystal site vacancies in the quantum well structure at a concentration below $6x10^{19}$ cm^{-3}.

5. (Original) The method of claim 1 further comprising, during the introducing step, introducing ions into a quantum well structure that includes:

a III-V material upper barrier layer;

a III-V material lower barrier layer; and

a III-V material quantum well layer.

6. (Original) The method of claim 5 further comprising, during the introducing step, introducing ions into a quantum well structure that includes:

an InGaAsP upper barrier layer;

an InGaAsP lower barrier layer; and

an InGaAs quantum well layer.

7. (Original) The method of claim 5 further comprising, during the introducing step, introducing ions into a quantum well structure that includes:

an InGaAsP upper barrier layer;

an InGaAsP lower barrier layer; and

an InGaAsP quantum well layer.

8. (Original) The method of claim 5 further comprising, during the introducing step, introducing ions into a quantum well structure that includes:

an InP upper barrier layer;

an InP lower barrier layer; and

an InGaAsP quantum well layer.

9. (Original) The method of claim 5 further comprising, during the introducing step, introducing ions into a quantum well structure that includes:

an InP upper barrier layer;

an InP lower barrier layer; and

an InGaAs quantum well layer.

10. (Original) The method of claim 5 further comprising, during the introducing step, introducing impurity ions into a quantum well structure that comprises:

an AlGaAs upper barrier layer;

an AlGaAs lower barrier layer; and

a GaAs material quantum well layer.

11. (Original) The method of claim 5 further comprising, during the introducing step, introducing ions into a quantum well structure that includes:

an AlGaAsP upper barrier layer;

an AlGaAsP lower barrier layer; and

an AlGaAsP quantum well layer.

12-16. (Cancelled)

17. (Original) The method of claim 1 further comprising, during the introducing step, introducing ions into a laser waveguide quantum well structure.

18. (Previously Amended) The method of claim 1 wherein:

the quantum well structure further includes an upper cladding layer disposed above the upper barrier layer; and

the introducing step includes introducing the ions into the upper cladding layer.

19. (Previously Amended) The method of claim 1 wherein:

the quantum well structure further includes an upper cladding layer disposed above the upper barrier layer; and

the introducing step includes introducing the ions into the upper cladding layer such that the impurity ions are at least 0.5 micron from the upper barrier layer.

20. (Original) The method of claim 1, wherein the thermally annealing step is conducted at a temperature above 450 °C for a time period in the range of about 2 seconds to about 3 minutes.

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21. (Previously Amended) The method of claim 20, wherein the thermally annealing step is conducted at a temperature above 600 °C, and wherein the quantum well structure contains InP.

22. (Previously Amended) The method of claim 21, wherein the thermally annealing step is conducted at a temperature above 700 °C, and wherein the quantum well structure contains GaAs.

23. (Original) The method of claim 1, wherein the introducing step employs an ion implantation technique.

24. (Previously Amended) The method of claim 1, wherein the introducing step employs an implantation dosage of greater than $1x10^{12}$ cm^{-2}.

25. (Original) The method of claim 23, wherein the introducing step employs an implantation energy of no more than 400 KeV.

26. (Original) The method of claim 1, wherein the thermally annealing step induces a bandgap energy shift of at least 60 meV.

27. (Previously Amended) The method of claim 1 further comprising, after the introducing step and before the thermal annealing step, depositing a capping layer on an upper surface of the quantum well structure.

28. (Previously Amended) The method of claim 1, wherein the quantum well structure further includes a layer doped with a high mobility impurity and is back-spaced by at least 0.1 μm from at least one of the quantum well layer, the upper barrier layer and the lower barrier layer.

29-30 (Previously Cancelled).

31. (Original) The method of claim 1, wherein the introducing step employs a focused ion beam.

32. (Original) The method of claim 1, wherein the introducing step employs a dense ion plasma.

33. (Previously Amended) The method of claim 1, further comprising the step of:

forming a patterned mask layer over the quantum well structure;

wherein the implanting step includes implanting the ions into a predetermined portion of the quantum well structure, at a temperature in the range of from about 200 °C to about 700 °C, using the patterned mask layer as an implant mask; and

wherein the quantum well interdiffusion is induced and the bandgap energy of the predetermined portion of the quantum well layer is shifted.

34. (Previously Cancelled)

35. (Original) The method of claim 33, wherein the forming step forms an SiO_2 patterned stress-inducing mask layer.

36. (Original) The method of claim 33, wherein the forming step forms a patterned stress-inducing mask layer on a substrate that includes the quantum well structure and wherein the patterned stress-inducing mask layer is formed of a material with a thermal coefficient of expansion that is at least 10 times different than the thermal coefficient of expansion of the substrate.

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37. (Original) The method of claim 36, wherein quantum well intermixing is induced with a spatial resolution of less than 3 microns.

38. (Previously Amended) The method of claim 33, wherein the quantum well interdiffusion is induced and the bandgap energy of the predetermined portion of the quantum well structure is shifted with a spatial resolution of less than 3 microns.

39-46. (Previously Cancelled)

47. (Previously Amended) The method of claim 36 further comprising, during the forming step, forming the patterned mask layer that includes a plurality of patterned mask layer portions, each of the plurality of patterned mask layer portions having a thickness that is different than the thickness of the other patterned mask layer portions, and during the implanting step, implanting ions into predetermined portions of the quantum well structure using the patterned mask layer to control the penetration of ions into the predetermined portions of the quantum well structure.

48-59. (Cancelled)

60. (Presently Amended) A method for shifting the bandgap energy of a quantum well layer comprising:

introducing ions into a quantum well structure at an elevated temperature and with an implant energy of no more than 400 KeV, <u>wherein the introduced ions are selected from a group consisting of oxygen, gallium, fluorine, nitrogen, boron, argon, arsenic, xenon and phosphorus; and</u> wherein the quantum well structure is formed over a substrate and includes at least:

an upper barrier layer;

a lower barrier layer; and

a quantum well layer disposed between the upper barrier layer and the lower barrier layer;

wherein the ions are introduced no closer than 0.5 microns from the upper and lower barrier layers; and

thermally annealing of the quantum well structure to induce quantum well interdiffusion that shifts a bandgap energy of the quantum well layer.

61. (Previously Added) The method of claim 60, further comprising the step of:

forming a stress-inducing patterned mask layer on the quantum well structure before the introduction of the ions, wherein the patterned stress-inducing mask layer is formed of a material with a thermal coefficient of expansion that is at least 10 times different than the thermal coefficient of expansion of the substrate.

62. (Previously Added) The method of claim 61, wherein the stress-inducing patterned mask layer includes a plurality of patterned mask layer portions, each of the plurality of patterned mask layer portions having a thickness that is different than the thickness of the other patterned mask layer portions, and during the implanting step, the ions are implanted into predetermined portions of the quantum well structure using the patterned mask layer to control the penetration of ions into the predetermined portions of the quantum well structure.

63. (Previously Added) The method of claim 1, wherein the ions are introduced into predetermined portions of the quantum well structure with different dosages and/or different implant energies to vary the bandgap energy shifts induced therein by the quantum well interdiffusion.

64. (Previously Added) The method of claim 63, wherein:

the bandgap shift for one of the quantum well structure predetermined portions is selected to form a passive optical device; and

the bandgap shift for another one of the quantum well structure predetermined portions is selected to form an active optical device.

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65. (Previously Added) The method of claim 64, wherein the passive optical device is an optical waveguide or a multi-mode interference couple, and the active optical device is an optical modulator or an optical amplifier.

66. (Previously Added) The method of claim 65, wherein the quantum well structure predetermined portions form an optical switch, with optical waveguides connecting a plurality of optical amplifiers to a multi-mode interference couple.

67. (Previously Added) The method of claim 48, wherein the ions are introduced into predetermined portions of the quantum well structure with different dosages and/or different implant energies to vary the bandgap energy shifts induced therein by the quantum well interdiffusion.

68. (Previously Added) The method of claim 67, wherein:

the bandgap shift for one of the quantum well structure predetermined portions is selected to form a passive optical device; and

the bandgap shift for another one of the quantum well structure predetermined portions is selected to form an active optical device.

69. (Previously Added) The method of claim 68, wherein the passive optical device is an optical waveguide or a multi-mode interference couple, and the active optical device is an optical modulator or an optical amplifier.

70. (Previously Added) The method of claim 69, wherein the quantum well structure predetermined portions form an optical switch, with optical waveguides connecting a plurality of optical amplifiers to a multi-mode interference couple.